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FIG. 1.—THE CANE CACTUS OF SOUTHEASTERN COLORADO, SINGED WITH BRUSH.

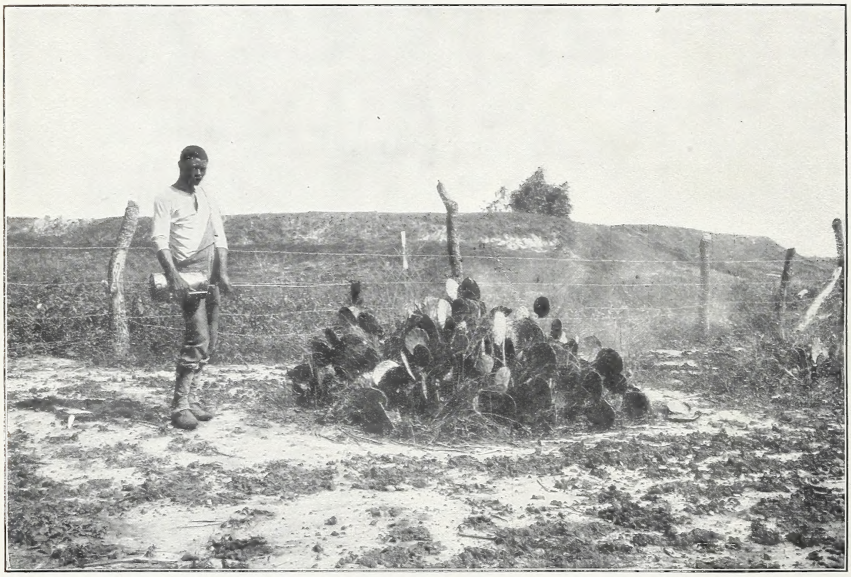

FIG. 2.—THE PRICKLY PEAR OF TEXAS, SINGED WITH A TORCH.

OLD AND NEW WAYS OF SINGEING CACTI.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 74.

B. T. GALLOWAY, *Chief of Bureau.*

THE PRICKLY PEAR AND OTHER CACTI AS FOOD FOR STOCK.

BY

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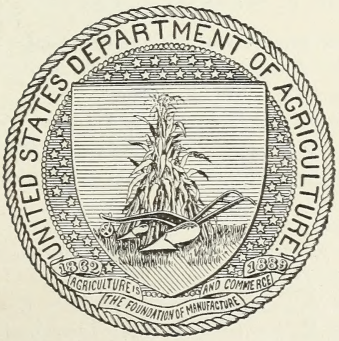
GRASS AND FORAGE PLANT INVESTIGATIONS.

ISSUED MARCH 8, 1905.



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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., December 14, 1904.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 74 of the series of this Bureau, the accompanying manuscript entitled "The Prickly Pear and Other Cacti as Food for Stock." This paper was prepared by Dr. David Griffiths, Assistant Agrostologist in Charge of Range Investigations, and has been submitted by the Agrostologist with a view to its publication.

The five half-tone plates are necessary to a complete understanding of the text of this bulletin.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

For several years past letters have been coming to this Office regarding the forage value of different species of cactus. Some two years ago a number of letters were received in which the writers claimed high feeding value for this class of plants when properly handled. The fact that much land which must be classed as desert is covered with a considerable growth of cactus plants, and the certainty that if these could be shown to have forage value the fact would render useful enormous stretches of lands which are now even worse than useless seemed to justify investigating the subject.

Our first efforts were to collect the experience of those who had used prickly pear and other cacti for feed. The amount of information secured in this manner was astonishingly large, and being on a subject which had hitherto received practically no attention from investigators in this country, much of it was of a nature to create some surprise. The information thus gleaned is here presented as a basis for further work, which is now under way. While the opinions of those who have had experience in feeding cactus are not always justified, they are nevertheless suggestive and are presented in the following pages because of the value of some of these suggestions. In view of the large amount of information collected by Doctor Griffiths, it is somewhat remarkable that investigators have not heretofore recognized the possibilities evidently existing in the cacti as forage plants. It is shown that this use of them is very old and is quite general over a large extent of territory in this country. In this connection it may be remarked that were it not for the spines on this class of plants they would probably have been exterminated long ago, and there is some doubt whether there would be any use for spineless forms in the future. It is practically certain that under no circumstances does the prickly pear possess as much forage value as some enthusiastic feeders claim for it, but the subject is certainly worthy of the investigations that have been undertaken. The principal lines of investigation now in progress are: Chemical composition of the most useful forms, methods of planting, yield, the frequency with which cacti may be harvested, varieties and their distribution, methods of preparation and feeding, and the value of these plants compared with other forage plants.

We have been able to find only very meager accounts of any previous investigations in this field. A little has been done in Australia and in India. The results of these investigations are not in accord with the experience of stockmen in this country. In reporting on feeding trials in India, the experimenter says, "The result of our extended and thorough trial proves conclusively that prickly pear has hardly any value as a cattle feed." In the experiments referred to, the cactus was roasted in order to remove the spines. The experience of American feeders indicates that the unfavorable results in these experiments may be due to the method of preparation of the material. They may also, of course, be due to differences in the species used, but the fact that practically all forms of cactus found in this country make very good famine feed would point to a different conclusion. The cattle on experiment in these investigations in India at no time consumed over 25 pounds of cactus per day, while numerous instances are known where cattle in this country have eaten 100 pounds or more per day.

It would seem that when fed with a limited amount of cotton-seed meal, properly prepared cactus is readily eaten in large quantities and that it has considerable feed value. Prickly pear has undoubtedly saved many herds in famine years and thus prevented the wiping out of the ranchers' capital—often the result of years of patient labor.

Other publications will be issued as the investigations now in progress are completed. These investigations are being conducted by Dr. David Griffiths, of this Office, under the direction of the Agrostologist. In this work we are cooperating extensively with the New Mexico Experiment Station and with a large number of stockmen in the Southwest.

W. J. Spillman,
Agrostologist in Charge.

Office of Grass and Forage Plant Investigations,
Washington, D. C., December 5, 1904.

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THE PRICKLY PEAR AND OTHER CACTI AS FOOD FOR STOCK.

INTRODUCTION.

In the arid and semiarid regions of the United States the rancher is periodically confronted with a condition of drought which endangers the well-being, if not the actual existence, of his flocks and herds. His pastures are usually taxed to their utmost capacity during average years, and when a season of famine occurs he suffers tremendous losses by death of animals. Under these conditions he is obliged to sell when neither his stock nor the market prices are favorable to his interests. Under such circumstances it is sometimes advisable to buy hay or grain, but the prices of these feeds where freight rates are high are often prohibitive. It is very seldom that a rancher can afford to feed hay at $10 per ton to stockers, even if it can be secured conveniently.

The case is much more aggravated when the haul to the feeding grounds is long, necessitating a considerable expenditure of money for hauling the same expensive feed. This latter expense may often be obviated by driving the stock to a region in close proximity to the feed; in other words, to the feeding ground. This common practice in the West is a very important factor in the stock business. Stockers are shipped from the southwest to the Pacific coast, Montana, and Canada to take advantage of feed in those localities when it is unobtainable in the southern breeding grounds. The practice, while common, if not universal, is expensive, because of the long distance to feed. Short pasture and the settling up of the intervening regions render driving impracticable, although formerly this could be more easily done. The large holder usually has a knowledge of the conditions which prevail in other sections of the country, and his superior experience gives him a decided advantage over the small rancher, who has less means and usually less knowledge of the conditions of the country at large at his command. The rancher of moderate means is therefore confronted, during years of famine, with the alternative of feeding expensive feed or selling at ruinous prices in order to save his stock from starvation.

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It is to meet the requirements for an emergency ration for these seasons of short feed and to call attention to the varied uses of the cacti that this bulletin is published; and it is hoped that it will answer, in a preliminary way, many questions which are asked of the Department of Agriculture each year regarding cacti.

The various species of cactus which occur in the arid and semiarid portions of the country are well adapted to the purpose of feeding when properly prepared, and furnish a feed which, although low in nutritive value, is inexpensive and will tide the stock over a period of shortage.

This bulletin is based upon personal observations and the experience of ranchers, and was instigated by the numerous inquiries and pressing demands which have been apparent for the past few months. This publication is a preliminary one, giving a general exposition of the subject. It will be followed later by several technical treatises, which are now in process of preparation, dealing with carefully planned experiments upon the different phases of the subject. Here technicalities are avoided, and the aim in writing has been to include such information as has been secured by field observations and inquiry among ranchers, dairymen, teamsters, and others having experience in the premises. The paper is therefore intended to be popular, suggestive, and preliminary to more technical publications which are to follow.

HISTORY.

It is impossible to tell where or when the feeding of pear began in Texas, but it is certain that the practice was common several years before the civil war. There are people now living who can remember distinctly its use during the droughts of 1857 and 1859. From this time until long after the war there were very extensive freight transportations carried on between Brownsville, Indianola, San Antonio, Eagle Pass, etc. Teaming was especially heavy in this region during the civil war, when Brownsville and Matamoras, Mexico, became bustling, flourishing cities, built up by the teaming trade, which brought the products, especially cotton, of the Confederate States to this point for export—at times the safest outlet for the products of the South. By far the greatest amount of freighting was done with oxen. At that time corn was not produced in any appreciable quantities, and any other grain was prohibitive in price. Upon their long hauls the cattle got no feed but that produced by the country through which they passed. This was meager in localities and often poor everywhere. It is said that the teamster considered himself fortunate when there was pear to be had, and there was plenty of it on many of the roads. The teamsters at this time scorched the pear by burning brush, and chopped or slashed it with ax, spade, or

machete. This, together with such dry grass and browse as the region afforded, was all the feed that the cattle obtained.

It is quite probable that the Americans learned the use of prickly pear from the Spanish people, who appear to have learned its value and practiced feeding it long before it was employed for that purpose in this country.

GEOGRAPHICAL DISTRIBUTION OF ECONOMIC CACTI IN THE UNITED STATES.

Roughly speaking, we may designate the northern boundary of the cactus area in this country as follows: From the Texas–Louisiana line westward on the thirty-third degree of north latitude to the Texas–New Mexico border; thence, northward to the thirty-ninth degree of north latitude; thence, westward along this parallel. In describing the boundary in this manner it is to be understood that only a very small fraction of the area of the United States south of this line has pear or other cacti in sufficient quantity to be of economic importance in a state of nature. Indeed, the areas of economic cactus in this country are very circumscribed, although they are scattered over a considerable territory.

Outside of this area there are only one or two situations where the cacti are at all prominent, and they never grow large enough to be of any particular value. The same is true of much of the territory included in the general region designated above, but some of this territory is covered with growths of various species of these spiny plants that render it difficult for cattle to travel through them, and such growths are scattered here and there over the entire region.

The cactus region par excellence, and the only region where any great amount of feeding has been done in this country, may be described as that portion of Texas situated south of the thirtieth parallel of north latitude. In this region the species of prickly pear are sufficiently abundant and the grasses so scarce during portions of the year that the stock industry becomes almost dependent upon the pear for its existence. It is estimated by many ranchers that one-half less stock would have to be handled by them were it not for prickly pear.

In the general cactus region outside of southern Texas, cactus from an economic point of view occurs in limited areas only. Arizona, New Mexico, and southern California, while often spoken of as great cactus regions, have only comparatively small areas where any of the species grow in sufficient abundance to render them of any commercial importance in a condition of nature. These States have many botanical species of great interest, but in many cases the number of individuals is small, or, if numerous, they are too diminutive to be economically prepared for stock feeding.

But even so, there are many areas scattered all over these regions

where some of the various species occur in great profusion, giving a reserve food supply which under intelligent use can be made immensely valuable, even if the plants will not respond readily when planted. The experience of a few ranchers in the vicinity of Magdalena, N. Mex., the Pinal Mountains and Colorado River Valley of Arizona, and in southeastern Colorado testifies to the value of the various species of cactus as emergency rations in the general region south of the thirty-ninth degree of north latitude and west of eastern Texas.

METHODS OF FEEDING.

In Australia, so far as the literature of the subject indicates, steaming is the principal method of utilizing the prickly pear, which has been introduced and widely disseminated in that country. In this country various methods have been developed independently in the several cactus regions, and apparently, at least, without knowledge of the practices in vogue in other sections. The greatest progress in this line, however, is exhibited in the vicinity of San Antonio, Tex.

SINGEING THE SPINES.

The most prevalent practice in southeastern Colorado consists in singeing the spines over a brush fire. (Pl. I, fig. 1.) This operation is practicable where there is considerable brush or wood conveniently situated, but it has many disadvantages. The plants are collected and hauled to some convenient place, where a fire is built. A brisk fire will remove the spines from one side of the joints almost instantly. It is then necessary to turn the plants over and burn them again on the other side. Some careful feeders often leave the plant on the fire until much of the outside has turned black from the heat, in order to insure the removal of the short as well as the long spines. Others exercise less care, and simply allow the flames to pass over the plant, burning off only the distal half or more of the long spines and leaving practically all of the short ones for the cattle to contend with. It often happens that the fuel used is greasewood (*Sarcobatus vermiculatus*) or shad scale (*Atriplex canescens*), the young shoots of which are of greater nutritive value than the pear itself. On the arroyos and washes dead cottonwood timber is used, while in many localities juniper furnishes the fuel.

This is the most primitive method of feeding and one which has been practiced in Texas since before the civil war, and is still very extensively employed not only in Texas but also in old Mexico, where singeing the thorns with brush is about the only method employed in feeding prickly pear and other species of cacti.

SINGEING WITH A TORCH.

The use of a gasoline torch for removing the spines of the prickly pear (and it is applicable to other species of cacti) originated in Texas. (Pl. I, fig. 2.) This is a common practice in vogue upon the range, and is to be recommended as economical in both the utility of the feed and the labor of preparing it. The process consists in passing a hot-blast flame over the surface of the plant, which can be very quickly done at small expense. The spines themselves are dry and inflammable. In many species one-half or two-thirds of them will burn off by touching a match to them at the lower part of the trunk. The ease with which they are removed depends upon the condition of the atmosphere, the age of the joints, and the number of the spines. A large number of spines is very often an advantage when singeing is to be practiced, because the spines burn better when they are abundant. The instrument used for this purpose is a modified plumber's torch. Any other convenient torch which gives a good flame can be employed, the efficiency depending upon the lightness of the machine and the ease with which the innermost parts of the cactus plants can be reached by the flame.

In southern Texas two excellent torches, described elsewhere, are commonly used in singeing the prickly pear. In Arizona one or two ranchers consulted have used an ordinary kerosene torch with moderate success in handling the tree cacti of that region. With the use of these machines there is no labor involved in the feeding, except that of removing the spines by the passage of the blast flame over the surface of the joints. The cattle follow the operator closely, and graze all the joints which have been singed.

STEAMING.

So far as known, Mr. J. M. John, of Hoehne, Colo., is the only rancher who has practiced steaming cactus for cattle in this country. Mr. John discovered by accident and without any knowledge of Australian practices that the spines became innocuous when moistened for some time. He happened to use the plants in the construction of a dam, which soon washed out. Upon repairing the dam it was discovered that the spines of those plants which had been kept wet were perfectly harmless. This suggested that hot water or steam would accomplish the purpose in a much shorter time. Acting upon this suggestion he fitted up a tank and boiler, which happened to be on hand, for the purpose of steaming the cactus. The tank employed was an open one holding two loads, or, approximately, 6,000 pounds of cactus. In order to prevent the loss of heat as much as possible, corn chop, which was to be fed with the cactus, was poured upon the top of the loaded vat. This mixture was steamed for about ten hours,

allowed to stand one night, and fed in the morning, with good results during one or two winters. It should be stated that all of the liquid was lost. This was a pure experiment, adapted to local conditions and material convenient for the operations. The form of tank, the length of time, and the consequent expense of keeping up steam, could be greatly improved upon.

CHOPPING BY MACHINERY.

In southern Texas there have been some rapid advances made during the last twenty years in the matter of pear-handling machinery. By use of the machines now in vogue pear and other cacti may be chopped into such small pieces that the spines are rendered innocuous by the abrasion. The two machines manufactured for this purpose and described later are both set so as to cut the pear into 1-inch to 1½-inch pieces. Owing to the succulent nature, the whole thing is practically macerated in the operation. It is the practice to set these machines up in the pastures convenient to pear and water. The pear is cut down, hauled to the machines in wagons or carts, chopped, reloaded, and hauled out again to be fed in troughs constructed for that purpose.

A further discussion of this topic will necessarily occur in connection with a description of the machines and their operation.

OTHER CHOPPING DEVICES.

Many feeders in Texas hire cheap labor to chop the prickly pear with machetes or spades. A small quantity of the pear is placed in a trough or a pile is built upon the ground. A machete or spade is then employed to slash it into small pieces, when it can be more readily eaten by the cattle. This is rather a poor way of feeding, for the spines are only imperfectly gotten rid of, and the cattle consequently get their mouths so full of them that after a time they are unable to eat at all. The practice does get rid of some of the spines, however, and stock are able to eat the pear much better when prepared in this way than in the natural state.

REMOVAL OF THE EDGE OF THE JOINTS.

All pastors (herders) carry machetes as a part of their equipment in all prickly-pear regions of Texas and Old Mexico. With this most useful Mexican instrument they very dextrously lop off the edge of the pear joint for the purpose of giving the sheep a chance to get into the thickets or bunches of pear to better advantage. As a usual thing the greatest number of spines occur on the edges of the joints, the more effectually protecting them. The pastors simply cut off an inch or two of this spiny portion and the animals are then able to

nibble at the cut surface without serious injury. This practice has probably done more toward the creation of impenetrable thickets than any other, for a large number of the pieces which are cut off strike root and grow.

HANDLING THE PLANTS.

The species of cactus which is fed in southeastern Colorado is one of the so-called tree cacti. The spines are very numerous upon this species, rendering it difficult to handle, so an ordinary fork is used to collect and handle it over the fire. Some feeders employ an ax in cutting the tree down, but the majority of them use a fork for that purpose also. A comparatively light pressure of the fork against a large limb is sufficient either to break it off or cause it to split at the crotch, when it can be loaded directly on the wagon which is driven along for this purpose. The limbs break off very readily when they are frosty. If collected in cool, crisp mornings, therefore, chopping is not necessary, for a simple pressure of the fork will break off a large limb. An average load upon a hay frame will weigh 2,000 to 3,000 pounds. This the collector can gather and throw upon the wagon with no particular attention to the arrangement of the plants, as with

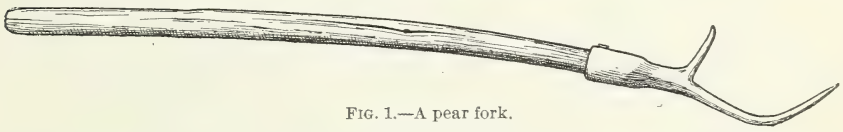

FIG. 1.—A pear fork.

a load of hay. The practice in vogue requires a great deal of handling. The plants are first loaded on the wagon, thrown off in heaps, forked over at least twice in the singeing, and then thrown out to the cattle to feed upon. This makes not less than four handlings. The feed is comparatively easy to handle, however, a large branch, such as is usually obtained, weighing as much or more than an average forkful of hay.

In southern Texas the handling does not differ very materially from that described for southern Colorado, except in unimportant details. Here, on account of the peculiar influence of the Mexican labor employed, the methods are often very primitive. Instead of a fork, a sharpened or forked stick is often used in gathering and hauling the pear of this region. In feeding to the pear choppers a stick is invariably employed, on account of the danger to the knives of the machine when an iron fork is used.

In some cases a specially constructed fork (fig. 1) is used by the freighters. This instrument has a handle much like an ordinary pitchfork; the tine, however, is single, short, stout, and sharply curved, with a stout buttress or projecting arm at the base to prevent the soft joints through which the instrument is thrust from sliding

upon the handle when raised above the operator in the act of pitching upon the wagon. None of these was seen upon the ranges, but such forks were commonly used by the wood choppers and freighters.

The vast majority of the Mexicans use a forked stick, and this is the only method of handling which was observed in old Mexico, where pear feeding is very extensively practiced.

PEAR MACHINERY.

So far as the writer is aware, all pear machines that have been invented—and there are four of them—have emanated from the country tributary to San Antonio, Tex. At present there are four machines in common use, two choppers and two torches, as described below.

ORIGIN OF PEAR MACHINERY.

Dr. W. S. Carruthers, a retired army surgeon, is said to have originated the idea of pear-cutting machinery. Doctor Carruthers submitted a sketch with notes to a foundryman at San Antonio, Tex., who put the idea into mechanical execution about 1886 or 1887.

The first machine was constructed of wood. It consisted essentially of a vertically mounted revolving wheel, with an iron band shrunken upon it in much the same way as the tire of a wagon wheel. Knives for cutting the pear were fastened to the surface of this wheel. It was not essentially different in principle from the machines of more modern construction. Although many mechanical improvements on the original machine have been made, it is admitted that the honor of the invention belongs to Doctor Carruthers, who not only designed the original, but was the first to operate a pear-cutting machine.

Mr. T. R. Keck, of Cotoula, Tex., who was associated with Doctor Carruthers during his experimentation with his first machine, reports that the first machine used was made by himself out of boards and two old hay knives. This machine was used one winter on a very small scale as an experiment in testing the efficiency of pear and cotton-seed meal for fattening cattle. The following winter about 5,000 head of cattle were fed upon cotton-seed meal and machine-cut pear. Mr. Keck reports that the first homemade machine was used in 1885, as nearly as he can remember.

Since the invention of the pear choppers, some feeders have used some of the standard fodder cutters with moderate success. It is difficult to feed pear to these machines, however, for they are not run at a high enough rate of speed to get rid of the spines. They are not suitable for handling pear.

PEAR CUTTERS.

The machine shown in Plate II, figure 2, consists essentially of a solid cast-iron wheel, 4 feet in diameter, with two knives arranged at a narrow angle with the radius on one of its faces. Behind each knife, hollowed out of the face of the solid casting, there is a pocket extending the length of the radius. The front face of this wheel is plain, save for these pockets, which receive the chopped pear and carry it out of the machine. These are 1¼ inches deep, 22 inches long, and 9 inches wide. The back of the wheel is made irregular by the projection of the knife pockets, radial thickenings, and a perimeter 2 inches wide, for strengthening the casting.

The knives are bolted on to the face of the wheel over the pockets, and are one-half inch in thickness, with a bevel toward the wheel. In revolving, the knives pass a shear plate which is adjustable and bolted into the frame.

The wheel is supported vertically on a horizontal shaft running in boxes supported on a wooden frame. The wheel is operated by a pair of gears with a ratio of 5½ to 1, the shaft of which is squared to receive the knuckle of the horsepower ground rod. The main shaft also has sprockets for the operation of the carrier chain. To it also may be attached a pulley for the adaptation of steam power. When the machine is set up, a short chute is bolted at an acute angle with the face of the vertical wheel, in such a position that it terminates in the same horizontal plane as the axis of the wheel. The pear is forked into the chute, fed against the face of the wheel with its revolving knives, and is cut and mashed into small pieces. The chopped material is carried down in the pockets and dropped into a carrier, operated upon the same principle as the common straw stacker, which carries the chop off into whatever receptacle is provided for it. This is usually the ordinary wagon box, for the chop is hauled directly from the machine to the feeding ground.

The machine as operated by Mr. J. C. Glass, of Eagle Pass, Tex., has a few labor-saving devices attached to the regular construction as shipped from the factory. Upon the cutting side and opposite the horsepower a large platform about 3½ feet high is constructed to reach up to and partially surround the wheel. This is large enough to hold one day's feed of uncut pear, which is thrown on to it from wagons. From this platform the pear is fed into the chute, which is situated just above it. Under the elevated carrier is constructed a triangular box of about the same capacity as a double wagon box. On the lower end of this is a trap gate which can be sprung so as to allow the chop to slide into the wagon with no handling. The cost of the machine, together with the additional construction, is about $125.

The machine has never been worked by Mr. Glass to its full capacity, but an estimate can be made of its efficiency from the operations during the drought of 1902. At that time an average of seven or eight men was employed, and they cut pear for 1,500 head of cattle. Ten men could be employed to better advantage, and it is estimated that this number could, with pear conveniently at hand, cut a full ration for 2,000 head of cattle. This means that the machine would be operated ten hours a day, and that four horses would be necessary to furnish the power. The machine is calculated to be run by two horses, but four operate it to much better advantage, especially if heavy, old pear is used and a large amount of material is to be cut.

It was the practice here to run the machine only about six hours a day, the entire crew being employed in cutting and feeding and in gathering pear from the field. The cutting occupied the forenoon and a part of the afternoon, while the gathering required only a portion of the afternoon of each day. By employing men enough both to run the machine and gather the pear, thereby operating the machine ten hours a day, there is little doubt that ten men could feed 2,000 cattle a full ration. Seven men constitute the operating crew, and three can supply them with pear if the haul is not too great.

The machine shown in Plate III, figures 1 and 2, is constructed throughout of iron. It has a 36-inch revolving wheel, in which three adjustable knives are set at a narrow angle with the radius of the wheel. Behind each knife are set cast-iron pieces, which, bolted upon the wheel, make a box 2½ inches deep opening upon the periphery. The entire wheel is cased in, except the delivery opening, through which the chopped pear is thrown out of the machine. The knives cut against a shear plate, essentially as in the machine first mentioned, and a feed hopper or chute is built of boards, as described for that cutter. No carrier is used with this machine, for the centrifugal force of the revolving wheel throws the cut material 30 or 40 feet. A back stop 10 feet high is usually built to stop the chop, where it can be shoveled up handily.

If the cutter is run with an engine and fed steadily, the centrifugal force delivers the chop into a wagon, but with a horse power and unsteady feeding the motion is not uniform enough for this, and the chop must be shoveled into the wagon. The wheel makes about 225 revolutions a minute when operated by four strong animals. It is claimed that it will chop 20,000 pounds of pear an hour.

Mr. T. A. Coleman, of Encinal, Tex., operates this cutter with an engine, and all of his hauling is done in the common Mexican ox cart. A cover is constructed of lumber to fit the carts. This is put in place and fastened down, when the cart is backed up to the machine in such a position that the chop is delivered into the rear end, which is left

open, by the centrifugal force of the revolving wheel. In this way the carts are not only thoroughly but uniformly filled.

While the pear is passing through the machine the spines become thoroughly broken up, and, being lighter than the pulpy material, are largely winnowed out when the chop passes out of the machine. Ranchers report that this is very noticeable when the machine is in operation, the stream of broken spines and lighter material being quite effectually separated a few feet from the machine.

With this, as with the other machine, it is necessary to build a platform and a feed chute from which the pear is fed with sticks, as previously described. The chute is in the form of a flat trough, set at an angle of 45 degrees from the face of the wheel, its base being coincident with the horizontal diameter. The pear to be chopped is in this way carried into the machine by its own weight for the most part, but, owing to its straggling method of growth, its passage into the machine must be facilitated by the use of crude forks. The machine differs from that shown in Plate II, figure 2, in being constructed of iron throughout, in being smaller and more compact, in having the boxes behind the knives removable, and in utilizing the centrifugal force of the wheel in discharging the chop.

Both machines are reported to be very efficient. There is but little about them to wear out, and they are reported to last indefinitely.

PEAR BURNERS.

Pear burners were first manufactured in 1898. As now used they are essentially a modification of the plumber's torch.

The two pear burners upon the market are very similar in construction and are both efficient machines, according to the best evidence that it has been possible to obtain. They consist essentially of a strong, well-riveted, metal tank, which in actual use is supported upon the shoulders of the operator by a strap; a long delivery pipe, and a burner for generating and consuming gas from gasoline. The two machines differ only in minor mechanical contrivances and in the form of the burner. It has been found by experience that it is absolutely essential that the tank be strongly built in order to prevent accident. Several of the first burners used were too light in construction and caused serious accidents. It is said that one or two men were killed by the explosion of the tanks and the burning of the gasoline.

The distinguishing features of one of the pear burners on the market are the turning joints of the delivery pipe and the simple coiled-pipe burner, which is covered with a sheet-iron cylinder to prevent escape of heat, to give direction to the flame, and to protect the burner in windy weather.

The other style of burner differs from the one just described mainly

in the burner, which is somewhat more complicated. The generated gas in this machine passes through a chamber filled with a bundle of fine brass wires before being ignited. It also has some safety arrangements for insuring the heating of the oil and consequent generation of gas, which are claimed to have merit.

Both machines require gasoline for their operation, and are handled to best advantage with a good quality of oil and in weather free from wind.

Practically no labor is necessary with the burners other than that of passing the blast flame from the torch over the surface of the joints momentarily. Indeed, it is not usually necessary to do this with over two-thirds of the plant, for there is commonly enough dead herbage at the base, and growing up through the pear plants, to assist in burning off at least one-half of the spines. Besides, the spines are commonly less numerous upon the old stems, and cattle experience but little difficulty in eating the remainder after the outer two to four joints have been freed of them. The process of singeing the joints with one of these machines is therefore not a laborious or expensive one. Indeed it is by far the cheapest method yet devised for utilizing the prickly pear. It has, however, one or two disadvantages which are discussed later.

Cattle brought up in pear pastures do not have to be taught to eat pear. They take to the feed very naturally. After a day or two of feeding the sound of the pear burners, or the sight of smoke when pear is burned with brush, brings the whole herd to the spot immediately, and they follow the operator closely all day long, grazing the pear to the ground—old woody stems and all—if the supply that the operator can furnish is short.

PEAR FOR MILK PRODUCTION.

It is universally recognized throughout the pear region of southwestern Texas that the plant has a decided tendency to increase the flow of milk. In spite of the fact that the average ranch feeder claims that pear is of little or no value in the summer, there are hundreds of people who feed more or less definite quantities of this plant from one year's end to another. It is always used as a supplementary ration. Pear alone has not been fed to a great extent, for it is recognized that it is properly a supplementary ration to a more concentrated feed. Mr. John Bowles, near Eagle Pass, has fed pear, with hay and bran, to a milch cow for the past three years and would not think of discontinuing the practice. Some dairymen in the small towns where pear is accessible feed it regularly, and nearly all of the Mexican families who keep a cow in town depend upon this as their mainstay.

One example of very successful feeding, where somewhat definite data were obtainable, came under the observation of the writer and

might be cited here. Mr. Albert Ingle, of Eagle Pass, Tex., keeps one Jersey cow to supply milk and butter for family use. The cow has the run of the commons about town, but the pasturage is very short the greater part of the time. In addition to what she can pick up in this way she is fed 3 quarts of bran, 1 quart of cotton-seed meal, and all the singed and chopped pear she will eat. Mr. Ingle was feeding when his place was visited. The quantity chopped that morning, he stated, was an average one, and weighed 35 pounds, which amount was fed twice each day. The cow at the time was raising a calf and furnishing milk for the family, and was in good milking condition. This shows that the amount of pear fed was large. The ration each day was 6 quarts of bran, 2 quarts of cotton-seed meal, 70 pounds of chopped pear, and what the animal was able to pick up on very short range. This ration is kept up during the year, except when the mesquite beans are abundant, when no pear is fed.

The experience of Mr. Alexander Sinclair appears to be exhaustive and intelligent. He does not claim for pear any great feeding value, but he uses it entirely, he says, for the succulence. So far as feed is concerned, even roughage of some other kind could be fed cheaper, but as a succulence for milk production there is but little that can be secured during the winter. Attempting, as he does, to maintain an equal milk and butter production during the entire year, green feed is essential for winter use. This is furnished by the prickly pear, which is fed during that portion of the year when there is no green feed. During a portion of the summer, succulence is secured from the native grasses. When these dry up green sorghum is fed, and during the remainder of the year prickly pear. In spite of the fact that the range feeders taboo the pear after it begins to grow, Mr. Sinclair has fed it well into May with good results.

The ration of a cow during the winter is about as follows: Cotton-seed meal, 3 pounds; brewers' grains, 9 pounds; pear, 100 pounds.

Besides the above, the cows have the run of brushy pastures and are able to pick up much in the form of dry grass and browse. The quantity of pear fed is only an estimate, but is thought to be very close to the amount which an average cow gets. Even with this apparently large amount of pear the animals never get all they want of it. With this feeding the milk production is greater in the winter than in the summer when the cattle are on good grass. This, however, is not considered to be due to any peculiar advantage of the pear over the native grass, but rather to the unfavorable temperature and the annoyance of insect pests in summer.

Originally it was the custom to chop the pear with a pear cutter, but during the past winter it was hauled a distance of six miles, unloaded in long rows in the feeding lots, and singed with a pear burner.

Mr. Thomas Duggar, of Hoehne, Colo., has fed the common tree cactus of that region to milk cows with good success. The information secured from Mr. Duggar, while not so definite as that which one is able to obtain from the dairymen around San Antonio, Tex., where the feeding is better established and not so much of an experiment, nevertheless indicates that the cane cactus of this region is probably as good feed for milk production as prickly pear. Cactus, singed with brush, has been fed with a good quality of hay for two or three winters with what is considered good results. Doubtless some concentrated feed stuff, such as cotton-seed products, or corn chop, would add very materially to the quality of the ration for milk production.

SOME DAIRY RATIONS INCLUDING PEAR.

The practice of feeding dairy cows upon a partial ration of pear is very common—indeed, general—in the entire region of the lower Rio Grande, and as far north as San Antonio, Tex. The necessity for feeding this plant depends upon the condition of the seasons. When the winter rains are abundant and green feed is plentiful no pear to speak of is fed; but during a dry winter it is resorted to as the most economical method of supplying the succulence so essential to the maintenance of a good flow of milk. The amount fed depends largely upon the quantity of pear available and the labor at hand for handling it. In some cases which have come under the writer's direct observation the pear has been hauled six miles to feed to dairy cattle, and it is as much prized by many dairymen as any other part of their feedstuffs.

Mr. J. W. Statcher feeds 100 dairy cows regularly for three or four months during the winter. The feeding begins when the leaves fall off the brush in the autumn, and continues until they appear again in the spring. The ration for a cow is about as follows: Cotton-seed meal, 2 pounds; cotton-seed hulls, 8 pounds; bran of wheat or rice, 1 gallon; singed pear, 40 pounds; the run of brush pasture.

Mr. J. G. Hagenson's practice does not differ materially from that of Mr. Statcher. Having no pear, however, he buys it at 25 cents per load, a load consisting of about 2,000 pounds. His cattle get a ration approximately as follows: Bran, 9 pounds; cotton-seed hulls, 10 pounds; singed pear, 30 to 40 pounds; the run of dry-brush pasture.

In order to secure a better idea of the practices in vogue in feeding pear in the vicinity of San Antonio than time for personal inquiry would warrant, a circular letter was addressed to several dairymen. The following questions and answers in connection with the above discussion give a good idea of the practices which obtain and the estimate placed upon the prickly pear of the region as a succulence for milk production. Answers to the questions proposed were furnished by

several dairymen. The following are considered typical, and are reproduced here practically in full:

(1) Do you feed prickly pear to your dairy herd? How many years has this practice been followed?

Answers.—(*a*) During the winter months only. (*b*) I do in winter; five years. (*c*) Yes; for fourteen years. (*d*) Yes; have fed off and on for a number of years. (*e*) Yes; during the winter time; for about twelve years. (*f*) I have fed prickly pear to my dairy cows for nine years.

(2) How long did you feed during the past winter?

Answers.—(*a*) About fourteen weeks. (*b*) All winter. (*c*) All winter. (*d*) Did not feed pear last winter, because other feeds were very cheap. (*e*) None at all. (*f*) Did not feed during the past winter, on account of having moved to a place where it was inconvenient to get it.

(3) How do you prepare prickly pear for feeding?

Answers.—(*a*) Make brush fire and burn thorns off. (*b*) I use a pear burner. (*c*) Singe the thorns off and cut it up. (*d*) I run the pear through a pear cutter and mix with cotton-seed meal and hulls. (*e*) Burn the thorns off; then chop in small pieces. (*f*) I first burn off the thorns with a dry brush fire, and then cut into small pieces with a large carving knife.

(4) How much pear do you feed a cow each day? If you do not know the exact number of pounds, estimate it as closely as possible. How many loads per day do you feed to how many cows?

Answers.—(*a*) I feed about two-thirds of a common water bucket full to each cow in the morning. (*b*) I give the cows as much as they can eat once a day. (*c*) About 10 or 15 pounds per cow. (*d*) I feed 1½ bushels to a cow each day. (*e*) One load of about 3,000 pounds lasts 16 cows about three days. (*f*) I give each cow about 6 gallons of pear cut up into pieces about 2½ inches square.

(5) What other feeds do you give the cows with pear? How much of each kind of feed per cow?

Answers.—(*a*) I feed cotton-seed meal and bran. (*b*) Bran and cotton-seed meal. (*c*) One quart of cotton-seed meal, 1 peck of cotton-seed hulls, and all the cane they want. (*d*) One quart of cotton seed, 1 quart of cotton-seed meal, and 20 pounds of hulls per day. (*e*) One and one-half quarts of cotton-seed meal, 8 quarts of wheat bran, 20 pounds of cotton-seed hulls. (*f*) I give my cows 10 pounds per day of a mixture of cotton seed and wheat bran, in addition to the 6 gallons of prickly pear.

(6) Do your cows have the run of any pasture while you feed pear?

Answers.—(*a*) Yes. (*b*) Yes. (*c*) Yes. (*d*) No. (*e*) Very little. (*f*) Yes.

(7) Do you consider that pear influences the flavor, odor, or quality of the milk in any way?

Answers.—(*a*) It does if fed more than two-thirds of a common water bucket full to each cow in the morning, or in any other way. Feeding at night affects the odor of the milk slightly and gives butter a pale color. (*b*) It increases the quantity of milk 40 per cent. (*c*) It does not affect the flavor or color, but it may reduce the weight or richness of it. It increases the quantity. (*d*) No; I do not think it influences the flavor, odor, or quality of the milk at all when fed as I have mentioned. (*e*) When too much pear is fed, and not enough solid feed, the milk has a peculiar odor, is very poor in quality, and blue in color. (*f*) Prickly pear does not injure the flavor of the milk. It increases the flow. Cattle are very fond of it.

(8) Do you have pear in your pastures, or do you buy it? If you buy, how much do you pay per load?

Answers.—(*a*) I have it in my pastures. (*b*) I have pear in my pastures. (*c*) Yes. (*d*) I buy it at 25 cents per load and haul it myself. (*e*) I buy my pear. It costs me 25 cents per load of 3,000 pounds. I haul it myself. (*f*) I have pear in my pastures.

(9) What is your estimate of the value of pear for milk production?

Answers.—(*a*) I consider pear very valuable as a feed, and it is a good milk producer. It is very healthful to be fed with cotton-seed meal, etc. (*b*) [No answer.] (*c*) It is far ahead of any kind of hay or forage, and mixed with meal or bran nothing can beat it. (*d*) Is a good milk and butter producer. (*e*) A very good feed when you have no roughage. (*f*) It does not pay to buy pear unless hay is scarce and dear. When sorghum hay is only $7.50 per ton, as it is now, hay is cheaper than pear at 25 cents per load when you have to haul and burn it.

(10) After a crop of pear has been cut, how many years will it take for another crop to grow on the same land?

Answers.—(*a*) About two; but this will depend a good deal on the season. Pear burners are discarded by some, for the reason that they destroy the plant. (*b*) The pear begins to grow the following year. (*c*) Three years. (*d*) It takes from three to five years to make good-sized pear. (*e*) I do not know, but think about two years. (*f*) About two years.

It is very difficult to formulate a definite opinion regarding the effect of pear upon the quality of milk. There appears, however, to be a very well-established opinion that it produces blue milk if not fed with concentrated feeds. There seems to be a great diversity of opinion regarding the flavor of milk from pear-fed cows. Many maintain stoutly that it produces a slightly bitter taste, which is less noticeable when a good ration of corn or cotton-seed meal is added, while others defy tests that will detect in any way pear milk from any other except by its poorer quality in cases where the amount of pear fed is large and the entire ration is of low nutritive value. Personally the writer has been unable to verify any of these opinions.

PEAR FOR FATTENING AND MAINTAINING CATTLE.

Since the early days when teaming was much more extensively practiced than at the present time, the bulk of the pear feeding in southern Texas has been done either to maintain stock or to prepare them for the market. While feeding cactus to dairy cows and work oxen is common all over the pear region, the amount fed for these purposes is insignificant compared with that used for maintenance and fattening. By far the greatest amount is fed as an emergency ration, to keep cattle alive during a severe and prolonged drought. For this purpose its value can not well be overestimated, for, as has been aptly said by many ranchers consulted during the past year, pear often means the difference between live and dead cattle. A drought of from four to seven months, as sometimes occurs, in a country which has no sod to speak of and where a large portion of the grazing is furnished by

annual plants of short duration, is fraught with serious consequences to the stock industry. A rancher works faithfully a fourth of his lifetime to get his herd up to the desired standard of numbers and quality when a drought strikes him and he is obliged to sacrifice possibly his entire herd. He naturally waits for the weather to change from week to week, until his animals get into such a condition that he dares not move them, and they are then in too low a condition physically to be disposed of at anything like what they are worth, to say nothing about what they have cost him. In such a plight he loses everything, or sells out at a figure which practically means an entire loss, when it is almost certain that if he could keep his animals alive for a month or two there would be feed again and he would be out of danger. It is this uncertainty of the seasons which has often made the grazing of native pasture both hazardous and expensive in the Southwest. The rancher with small means is often caught with his cattle so poor that he can not think of moving them to better pastures, even if he has the means and can find the feed. He waits day after day, hoping for rains which do not come, until his stock begins to die from starvation. Then it is too late to remove them to new pastures, for experience teaches that working or driving starving animals is invariably productive of tremendous losses.

It is in an emergency of this kind that the prickly pear and other forms of cactus become a boon to the rancher. It is owing to the existence of the prickly pear that the success of the rancher in southern Texas is largely due. A score of ranchers have acknowledged to the writer during the past year that were it not for pear they would have to move their cattle out of the country once every four or five years on account of droughts. Theoretically, a rancher can safely stock his pastures to their capacity during the years of poorest production only, for the weakest link in his monthly chain of feed measures his strength in the stock business. For what matters it if he can accumulate a herd of 500 head of cattle, if a six months' drought causes a loss of 30 or 60 per cent in his herd?

With plenty of pear or other cacti in his pastures, however, this danger is largely removed. He has in this crop a feed which does not deteriorate if not used for three or four or even ten years; it is as good at one time as another, and can be fed by him at a couple of days' notice under any circumstances, although it is the general belief that it is much more valuable in winter than in summer.

A brief report of feeders in various portions of southern Texas will be to the point at this juncture. None of these has accurate accounts of his feeding. Everything is pure estimate, almost entirely from memory, but the accounts which follow are based upon statements of responsible feeders, whose estimates are as accurate as could

be obtained without definitely planned experiments. Their experiences are of great value in planning future investigations and in suggesting to those who have not had experience how best to proceed in feeding these plants.

The Messrs. Furnish, of Spofford, Tex., have fed pear three winters. Two years ago they simply cut the cactus with a pear cutter and fed it in troughs with two pounds of cotton-seed cake a day for each animal. The following winter they scorched it with brush in the field and then chopped and fed it in the same way. Their experience appears to indicate that chopping does not destroy the spines sufficiently to prevent injury from them. During the first year they were feeding pear they lost many calves and they attributed the loss to this cause. They are confident that there is no danger for older stock. They experimented with a pear burner, but were not pleased with it, as their machine used up about a gallon of gasoline per hour under careful manipulation, and with the employment of cheap Mexican labor, much more. They discarded their machines and put the men at work singeing with brush, which, on account of the irresponsible labor available, they considered much more economical.

There are various ways of harvesting cactus. These people employ one or two men to cut the pear off with a hoe, and then another gang comes along and loads it on a wagon fitted usually with a hay frame. The felled pear is handled with forks, and from a ton to a ton and a half constitute a load. This is then hauled to the machine and chopped up. A machete is sometimes employed for cutting the cactus off at the ground.

It is claimed that the old stocks are much more nutritious than the younger joints. An effort is made, therefore, whenever extensive feeding is done, to go into the thickest, rankest pear areas and cut the plants off at the surface of the ground in order to get as much of the old stumps as possible. What relation there is between the young joints and these older stocks should be determined chemically as soon as possible. In practice it is always considered that the older joints and stalks are most nutritious.

The chop is loaded on to wagons and hauled to the feeding lot, where it is fed in large flat-bottomed troughs, 3 feet wide and 8 inches deep, the cotton-seed meal being sprinkled over the chop at the rate of about 2 pounds for each animal a day.

The first winter feeding was done steadily for two months, and the cattle were given all the pear they would eat, together with 2 pounds of cotton-seed meal. All stock had a limited run of brush pastures. After this first period of two months was up they fed a bunch of the poorer animals for two or three weeks longer until they got strong. These were then turned on to native pastures to "rustle" for themselves, while another bunch of weaker ones was fed two or three weeks

longer. It is a very common practice throughout the pear region to feed only the poorer stock. The herd is worked over every few days for the purpose of cutting out those animals which are weak and most in need of feed. These are fed until they get on the mend, and are then turned out to "rustle" for themselves in the pastures, while another bunch is fed in their place. Very often all that is attempted is to keep stock alive until grass begins to grow.

Pear is considered good roughage in time of need in this vicinity, although no one regards it as a nutritious feed and all prefer to give even the stock which they are only attempting to carry through the winter some concentrated feed with it. It is impossible to estimate the total quantity of pear fed by the Messrs. Furnish.

Three years ago Mr. M. T. Cogley, of Laredo, Tex., fed 40 head of cattle for ninety days on a daily ration for each animal of 1 quart of cotton-seed meal, increased to 3 quarts as feeding progressed, and 200 pounds (estimated) of pear, chopped with machetes. Three men did the feeding and hauling. The animals fattened well, but it is believed they were held too long for the best results. They are supposed to have weighed about 50 pounds less than would have been the case ten days earlier. The falling off is thought to be due largely to too prolonged feeding of cotton-seed meal, but also to some extent to wet weather, which made the pastures boggy.

Mr. T. A. Coleman, of Encinal, Tex., is among the most extensive, if not really the largest, feeder of pear in Texas, and his experience is as varied as any in the country. His feeding has been done both to save cattle and to fatten them, and both operations have been conducted with uniform success. During the past winter four methods of feeding were employed:

(1) One lot of steers was fed in a closed pen. When feeding began they were given 3 pounds of cotton-seed meal, which was gradually increased to 6 pounds as the feeding progressed. The pear they ate was chopped and fed to them in troughs at the estimated rate of 80 pounds to a feed, or 160 pounds a day. During the last ten days each received about 8 pounds of sorghum fodder a day. The feeding continued seventy days, and Mr. Coleman and his men assert that they never saw stock fatten in better shape than did these; while Mr. Cameron, a buyer with a varied experience, authorizes the statement that they were far above the average of fleshy cattle in that section.

(2) In one pasture, cattle were fed pear scorched with a gasoline torch and were allowed free access to cotton-seed cake in a self-feeder. The cake feeding in this experiment was especially unsatisfactory, and the use of the self-feeder will be discontinued. These cattle had the run of dry grass pasture in addition to the cake and pear fed.

(3) A third lot was fed cotton-seed cake in a self-feeder, and allowed

the run of dry pasture containing an abundance of pear, of which stock eat a great deal during the winter without any preparation whatever.

(4) A fourth lot was fed similarly to the first, except that only one-half of the amount of meal was used. These cattle were held in a large pasture also.

The first of these methods is said to have proved by far the most satisfactory. Some idea of the extent to which pear is resorted to in times of drought can be had from Mr. Coleman's operations during the drought of 1901–2. From the latter part of November to the 5th of May, four pear cutters and twenty pear burners were in constant operation. Besides these, there were employed as many as 50 men, who traveled through the pear thickets with machetes, cutting the pear down so that cattle could get into it and feed upon it without further preparation.

In some respects Mr. Samuel Wolcott's experience has been as varied and definite as any which has come under the writer's observation. The methods which he has finally adopted for his work are considerably at variance with the practices of other Americans. Instead of using machinery, he chops all the pear he feeds with machetes, and all pear is scorched on a brush fire just enough to take off the thorns. His method increases the labor of handling considerably in some ways; but having to entrust the work largely to an unintelligent class of labor Mr. Wolcott believes that the additional expense of using machinery with such labor would be greater than the additional cost of using the machete and brush fires.

It has been his practice, in feeding for beef, to turn the stock into a pasture of considerable size in the morning; there they get a large picking of grass and some browse. While they are in the pasture the day's ration is prepared. The troughs are cleaned and filled; the pear is singed, put in the troughs, and chopped, and cotton-seed meal is sprinkled over it at the rate of from 3 to 6 pounds for each animal. It was the practice during the past winter to feed 3 pounds for thirty days, 4 pounds for thirty days, and 6 pounds for thirty days, making in all ninety days' feeding. It requires about ten days to get the cattle into the habit of eating out of a trough, so that the feeding period really extends over a period of about one hundred days. In reality the feeding period is governed largely by the condition of the feed in the pastures. The cattle are turned out on to grass after ninety days of pear feeding. One pasture is reserved for finishing cattle which have been fed pear and cotton-seed meal during the winter. This pasture is, therefore, always in good condition; but the intention is to feed so that the period of ninety days will be up about the time that grass is in good shape in the spring. The cattle are marketed off of grass.

The feeding of 125 head was done by three Mexicans and a foreman. Were it not for cheap labor the cost of pear feeding in this way would

be considerable. With cheap labor, however, even this method is profitable in average years. This spring, cattle were fed on grass for two months after the pear feeding, but in an average year they are sold after four weeks' run on grass. The reason for the longer period this year was the prolonged drought of the spring season, which made pear feeding much less profitable than usually is the case.

It is Mr. Wolcott's practice to ship off grass or some other than the pear and meal ration, on account of the large shrinkage which the stock suffers after this kind of feed. If it were possible to furnish a partial ration of hulls to supplant a portion of the pear, he thinks that feeding would be very much more satisfactory; but it is to get rid of the expense of the hulls that the pear is resorted to.

In all cases in southeastern Colorado, as in Texas, only a partial ration of cactus has been fed. In some cases the remainder of the feed has been supplied in the form of corn chop, and in others cattle have had the run of poor pastures, as is almost universal in Texas. Mr. E. M. Bages, of Trinidad, Colo., during the past winter fed his 40 head of cattle 1,000 pounds (estimated) of cactus per day. He states that the pastures were so short that all the cottonwood leaves (*Populus* sp.) which had fallen during the past winter were cleaned up. They, however, got some grass as well as greasewood (*Sarcobatus vermiculatus*) and shad-scale (*Atriplex canescens*) browse. His practice was to gather one load of about 2,000 pounds of cactus on alternate days. The spines were singed off over an open fire of dead poplar wood. The stock were in poor condition when the ranch was visited, about the middle of April, but it is very questionable whether they would have been able to live at all without this additional feed.

Mr. J. M. John, of Trinidad, Colo., who is the only person in this country known to have steamed any of the cactus plants for cattle, reports that he had good success one winter in feeding daily to each animal 30 pounds of steamed cactus and 4 pounds of corn chop, together with a small ration of hay. A lot of poor cows was made into beef between the first of January and the middle of April upon a somewhat larger ration than the above. These data, while not so definite as one could wish, are suggestive and form a splendid basis for future work.

PEAR AS A HOG FEED.

While several reports have come to us through the Agricultural Gazette of New South Wales regarding the feeding of prickly pear to hogs, there appears to have been but little attention paid to it for this purpose in this country. The only place known to us where pear has been fed successfully to hogs is at the asylum in San Antonio, Tex. The feeding here is done in such a way that the data, while valuable, give very little idea of the amount consumed by each animal. The

results obtained appear to indicate, according to Mr. J. F. Branham, that hogs take to the pear for roughage as kindly as cattle.

The number of hogs fed on the place during the past year and a half has been in the neighborhood of 230 in all. Many of these were small and ate little or no pear. To this number of animals, during a period of one and a half years, were fed 400 bushels of corn, 2½ barrels daily of meat and bread scraps, and 3,000 pounds daily of pear.

In feeding, extreme care is said to be necessary to rid the pear of spines, for they are very injurious to the hog. During this feeding about one-half of one per cent was killed by the spines in spite of the great precautions exercised. The pear was all burned in the field by a gasoline burner, loaded on wagons and thrown into the pens, one man burning as fast as three men could cut and load. Each day's ration of 3,000 pounds required 2½ gallons of gasoline for the burning.

In many localities in the pear region of Texas it is the practice, as soon as the tunas (fruit) ripen and begin to fall off, to let out the few hogs which the rancher usually has to feed upon them. It is considered by all who have had any experience with this practice that hogs are very fond of these fruits, and fatten very rapidly upon them.

PEAR FOR SHEEP AND GOATS.

Mr. Albert Urban, one of the largest owners of sheep in the Laredo district at the present time, values the pear very highly. His sheep are run entirely without feed, even during the dry seasons. His pastors all carry machetes and cut the edges off of the joints to give the sheep a chance to get at the pulp without being injured by the thorns. His range is well adapted to sheep on account of the large amount of browse furnished by the guajilla (*Acacia berlandieri*) and the mesquite (*Prosopis glandulosa*). These, together with the pear chopped with the machete, furnish an abundance of feed when the grasses fail, and the latter obviates the necessity of driving to water as often as would otherwise be necessary.

Upon nearly every ranch of any note in the pear region a small flock of goats are run and held most of the time in the thickest pear and brush on the ranch. It is a universal practice to furnish them access to all the pear they will eat, by a liberal use of the machete. The amount of pear they consume depends upon the condition of the other feed, it furnishing the greater part of their ration during droughty seasons.

PEAR AS A RATION FOR WORKING ANIMALS.

The animals best adapted to working on pear appear to be oxen. They often work for months upon no other feed than dry grass, brush, and prickly pear. Instances of the use of scorched pear for oxen by the early freighters have been mentioned. Even now a large num-

ber of Mexican wood choppers in the extreme southwestern part of Texas use no other feed than pear and what grass or browse the country affords. Often the grass and browse are very small in quantity. These people simply scorch the thorns off with brush, although many of them do not even go to this trouble, as they simply slash into the plants with a machete enough to give the animals a start into the clumps.

Mr. T. A. Coleman finds that oxen can be used with great economy in feeding pear to cattle. His machines are set in a pear thicket, and the distance hauled during the past winter was an average of about one-half mile for the round trip. The pear was hauled to the machine by two four-ox teams, which hauled 36 to 40 loads a day, an average load weighing 1,500 pounds (estimated). The travel per team, according to this, was about 10 miles per day. The last load cut each day was placed in a trough in a small pen for the work oxen, and they always had all they would eat. They got no other feed and kept in good working condition during the entire feeding period.

There are hundreds of ox teams in the southwestern part of Texas that work all the year on a ration consisting very largely of pear all of the time, and practically nothing else for months. They belong mainly to the Mexican population, who freight and haul wood to the towns, ranches, and pumping establishments which are springing up somewhat numerously in that section. Their ration consists of such feed as the country produces. Grass and browse are the main feed when the seasons are good. It is during the dry seasons that the greatest quantity of pear is fed, but the freighter never omits it from his ration for working oxen. Even during the month of May, 1904, when grass was in the best possible condition and there was an abundance of it, pear scorched with brush was regularly fed. It is impossible to tell how much these animals eat.

A day spent upon the market plaza at Laredo, Tex., confirmed the statement which had been often heard regarding the large use made of pear by the Mexican wood choppers. When the men are asked what they feed, the answer invariably is "nopal" (prickly pear). One, of whom special inquiry was made, stated that he was hauling wood 30 miles (round trip), making two trips per week. His loads averaged three-fourths of a cord of mesquite wood. His oxen grazed very largely on grass at that time, but the greater part of the year they got little besides nopal, the thorns being singed off over a brush fire. His team was in good working condition.

The largest amount of freighting in the State of Texas at the present time is doubtless done below the line of the Texas and Mexican Railway. In this region there is an abundance of pear of good quality. Here, and in fact farther north, especially along the Rio Grande, teaming is still a business; but it is almost entirely in the hands of the

Mexican population, who own their oxen and carts, their sole holdings in many cases.

It is estimated by Mr. Jacobo C. Guerra that there are no less than 200 of these Mexican carts operating between Rio Grande City and the north. About 60 of these work at the business continuously, while the remainder haul when there is an exceptionally large quantity of freight to be moved. There are a few mule teams on the road, but by far the larger quantity of freight is hauled with bulls or oxen; even cows are sometimes hitched to the wagons. A team consists of 4 to 10 oxen hitched to a Mexican cart. Such a team will make a trip of 76 miles and back in ten to fourteen days. The longer time is the one most frequently used. Two trips per month is what the average team makes. They go practically empty one way, and haul 3,000 pounds on the other trip. This figures up, for those who work at the business all of the time, 10 miles per day, continuously, from one year's end to the other, and this over a very hard road, two-thirds of which is sandy. This work is done by these animals upon a ration of prickly pear and grass, when the latter is to be had; when there is no grass, pear alone suffices. There are long seasons of frequent occurrence when grass is next to nothing, and during these seasons nopal in large quantities is fed, the cattle getting little else. The season is both infrequent and severe when the hobbled ox can not get some feed out of a brush pasture. Frequently, however, the feed, aside from pear, is very small in quantity.

Probably the largest amount of teaming is done between Hebronville and Rio Grande City. There is no pear convenient upon the northern one-third of this road. It is therefore necessary for the teamsters to provide themselves with pear by hauling it over about one-fourth of the journey. This necessitates the hauling of pear 15 or 20 miles, which largely increases the total work done by the animals. The driver camps at night in a pear thicket, lights a brush fire, and in about thirty minutes scorches the thorns from enough pear for his team to eat during the night. Another feed in the morning is usually all they get. In some cases the animals are given a ration of pear at midday. These people are often provided with a pear fork, a description of which has already been given (see fig. 1, p. 15), while some of them use a sharp stick for handling the pear. In chopping the pear down an ax or a machete is used. Before leaving the pear thickets enough pear is scorched and loaded on the wagons to feed the teams until they return to the thickets again.

During a good season, like the past one, there is plenty of grass along the road, but in spite of this pear is fed. The animals do not eat so much of it as they do when the grass is short, but there is never a season when they will not eat a surprisingly large amount of scorched pear.

During long, dry seasons the water supply along the road becomes very scarce, and teams often are forced to make the entire distance of 76 miles without water, on a full ration of pear. Indeed, teamsters have informed the writer that during the winter their oxen drink only about once each week, but that they need water two or three times a week during the summer.

It is next to impossible to get a very definite notion of how much these people feed their stock. As accurate an estimate as it has been possible to secure allows one-half load of singed pear to 12 head of oxen for one feed, when two feeds a day are given the animals. A load will probably weigh from 1,500 to 2,000 pounds.

EFFECT OF PEAR UPON STOCK.

The views of ranchers are so much at variance regarding many points relating to cactus feeding that it is impossible to form a definite opinion regarding many features of the practice. There is a comparative unanimity, however, upon many points. There is need of experiments for their verification, for popular experiences and opinions are too indefinite and unsatisfactory.

Stockmen are very generally agreed that pear should be fed very gradually at first, many claiming that a week should elapse before a full ration can be safely fed. The reasons for this, however, will vary with the individual and the locality. Mr. Sinclair has abundant evidence that bloat is very easily caused in cattle that are not accustomed to the feed. Really, cattle look as though they were bloated after every feed, for the quantity eaten (125 to 200 pounds a day) is bound to cause a large distention of the stomach; but there appears to be no danger after the animals have become accustomed to eating it.

Stock fed on a full ration of pear scour more or less all of the time, and the injury from this source is of course very much aggravated if the cattle receive rough treatment. A half ration, with some drier roughage, such as sorghum hay, or even dry grass or browse, appears to produce less serious effects. This condition could not be otherwise with such sloppy feed. It occurs invariably with beet pulp, and the effects are probably very similar.

The condition of stock which have received pear during the winter appears to be very much better than that of those wintered on good dry-grass pastures. Feeders without exception make this observation. The experience of the Glass Brothers is very conclusive in this regard. In the winter of 1897 their pastures were so short as to necessitate their moving their cattle to rented lands, not, however, very far away. In the herd were 55 pregnant cows, too poor to be moved. These were held on the home pastures and fed pear chopped with machetes, together with 1 to 1½ pounds of cotton-seed meal daily. These animals were turned on grass on the 17th of March, and could have been

sold as grass-fat cattle in sixty days, while that portion of the herd wintered on dry grass was not fat until fall. Of course the effect of moving and the influence of the pound or pound and a half of cotton-seed meal must not be overlooked, but the influence of the pear was certainly very potent. This corresponds very well with the experience of feeders in southeastern Colorado, where cactus is commonly fed without any other feed except what stock pick up in native pastures. Here it is found that cactus fed in any form is of decided advantage in toning up the system, particularly of 2-year-old stock, which suffer especially on account of the condition of their teeth at this age. Many 2-year-old heifers upon the range are lost at this age from constipation, brought on, no doubt, by a long-continued diet of dry grass, which is often so short as to be difficult for stock of this age to get at it. This evil, it is said, is corrected by a few feeds of cactus.

Ranchers in Texas often lose a small number of cattle from the effect of the accumulation of fiber of the pear in the stomach. This condition is said never to occur with chopped pear, but to be common in cases where a pear burner or machete is used, and still more common in cattle which are forced to eat a large amount of pear in short pastures during dry seasons. The balls are said to be made up entirely of the fiber and spines of the pear. It is also claimed that fiber balls are never formed when stock have a reasonable quantity of grass or other roughage with the pear.

No manner of feeding cactus yet devised, without greater care than the feeder is usually willing to bestow upon the work, does away entirely with the evil effect of the spines. Singeing with a torch or brush is the most effectual in this regard, if sufficient care is taken by the operator. In practice, however, very little attention is paid to the small spines, the effort being to burn off the distal three-fourths of the large ones, leaving most of the small ones for the stock to contend with. Indeed, there is a prejudice—whether well founded or not it has been impossible to determine—against pear scorched to the extent necessary to insure the removal of all the small spines. It is claimed that cattle scour much worse upon pear which has been excessively scorched by either torch or brush flame. Another objection urged is that torch-scorched pear invariably dies if the flame is kept upon it long enough to insure the removal of all the spines. This is really an important matter for those who have but little pear in their pastures, as simply singeing off the larger spines does not check the growth of the plants at all, and all the singed plants not actually grazed grow the following season.

The spines invariably work into the skin and flesh of animals which have the run of pear pastures to a large extent, certain exposed portions of the skin being often literally filled with them. It is reported by butchers that they often find cattle and sheep so full of cactus spines

that their skinning knives are dulled by a few strokes, on account of the large number which penetrate through the skin into the flesh, requiring the cutting of thousands of spines in the skinning. Inquiry made among hide merchants at several places does not indicate that they recognize any deterioration at all on this account. They invariably report that they take no cognizance of this defect in their classification of material brought to them, although they admit that the value is sometimes slightly reduced.

It is invariably the practice, wherever chopping machines are used, to feed the chop as soon as it is cut. A rapid fermentation sets in usually within twelve hours, but the rapidity and time are dependent upon the condition of the atmosphere. Authentic cases of injury to cattle by the use of fermented chop have not been found, but feeders report that they dare not feed fermented pear on account of an apprehension of injury which it may do. Rather than run any risks the rancher prefers to feed immediately upon cutting. The process of fermentation is a very peculiar and interesting one scientifically, and of course has a decided economic bearing. There appears to be a great deal of difference in the behavior of different species in this respect, judging from specimens put up for museum use and for chemical analysis. Some joints dry quite naturally in a relatively short time, while others begin to ferment very soon after being removed from the plant. The Texas species which are fed may be cut and piled in large heaps for from four to six weeks without undergoing any apparent change except a slight desiccation; but when chopped, the fermentation starts in very quickly. There are indications that some species at least ferment much more readily when cut in certain ways, and the cultivated forms more readily than the native ones. It is well established that fermented cotton-seed products produce serious effects when eaten by cattle, and the rancher who mixes these products with his pear must necessarily feed before fermentation has had time to take place. The well-known effects of fermented cotton-seed products, and the rapidity, vigor, and nauseating effects of the fermented pear warrant the caution exercised by all who feed in this way.

CACTUS FOR THE SILO.

Attempts to prepare ensilage from prickly pear have been reported once or twice in the Agricultural Gazette of New South Wales, but, so far as the writer is aware, no definite results have been secured. The Messrs. Furnish, of Spofford, Tex., attempted it one year, but on account of the improper construction of the silo nothing came of the experiment.

There is but little use in the preparation of ensilage from cactus. One can always gather this plant in the green state at any time of the year, and the object of going to the trouble and expense of placing

the material in a silo is not very evident. Apparently there is little or nothing to gain, and the expense is considerable. The only way in which this can be made profitable is to mix the chopped pear with some other much drier feed in the silo.

PEAR THICKETS AND THEIR DESTRUCTION.

It has been but a few years since the ranchers in the pear sections of Texas were inquiring anxiously for some method which could be successfully employed in ridding the native pastures of what was considered an absolutely worthless and injurious weed—the prickly pear. It was asserted that the pear, like the mesquite (*Prosopis glandulosa*) and guajilla (*Acacia berlandieri*), was spreading rapidly and would soon overrun and greatly injure, if not destroy, large areas of pasture land. But this was before the combination of pear and cotton-seed meal as stock feed was appreciated. To-day the occasion for the destruction of the pear does not exist, and an absolute destruction would be a calamity indeed. In some sections, however, the artificial propagation by cuttings, brought about by the liberal use of the machete, has thickened up the growth of the plants to such an extent as to make it advisable to thin the areas somewhat in order to give the grasses, which are very often impeded in their growth, a better chance, as well as to give stock a freer opportunity to get through the pastures and enable the herds to be worked to better advantage.

Some ranchers report that they have succeeded in thinning out the thickets in rather a simple way. An effort is made to allow as large an accumulation of grass and weeds upon the fields as possible, preparatory to the thinning process. When the vegetation is dead and dry, fire is set to the pastures at a time when it will run to best advantage. This is usually after the heavy frosts of early winter. The fire does not kill the pear, as a usual thing, but the spines are singed off from a great deal of it, giving the cattle which are turned in later a chance at the succulent forage. After the fire there is, of course, but little for stock to eat except the pear. Heavy pasturing is practiced and the plants are closely grazed, resulting in the removal of a large amount of stuff, usually without killing many plants. After such treatment it takes several years for the cactus to grow up again so as to influence seriously either the growth of the grass or the handling of stock. This practice is resorted to also in order to destroy some of the brush, which often becomes detrimentally thick. Some idea of the extent of brush and pear developments in some sections of Texas can be gained from the statement that it costs $15 to $20 per acre to clear land which it is said was a comparatively open prairie thirty years ago.

The practice of slashing the pear bunches with a machete, spade, or other instrument in the field is a questionable one in many localities

where the cactus is already very thick. As stated above, large pieces of the joints, and often two or more whole joints, fall on the ground and are left there by the animals, they being able to handle the portion on the stem to better advantage. Some of these pieces die, but a very large percentage strike root and grow, thereby thickening the pear thickets unnecessarily. In some places the pear is already so thick as to interfere with grass production, and the condition is aggravated by the careless practice of slashing the pear in the field, thereby scattering it into unoccupied areas, where it takes root and thickens up, to the detriment of more valuable feed. With care on the part of the herder this could be very largely avoided. All that is really necessary in order to give the sheep and goats a good chance at the pear is to take off the edge of the big round joint. It is on the edge that the greatest number of the most offensive spines occur. Taking off this portion exposes the pulpy substance so that the animals can readily nibble it. However, instead of merely taking off the edge the careless pastor slashes right and left, with no object but to expose the plant to the animals. The result is as stated above. The pear is spread by this artificial means in areas where it is already too thick. This excessive cutting of the pear can especially be avoided in the feeding of sheep and goats, for they prefer, and it is the custom to give them, the younger, more tender joints. The remaining more solid portions of the plants are preferred for feeding cattle. So far as the writer is aware, no definite tests have been made of the comparative nutritive value of different portions of the plants, and it is therefore impossible to state just how much scientific foundation there is for the universal opinion that there is more nutriment in the old stems than in the young joints.

SPECIES OF CACTUS WHICH ARE OF FORAGE VALUE.

The Texas ranchers and the Mexican people generally recognize several varieties of the prickly pear. One often hears the Mexican people apply such names as *nopal pellon*, *nopal agrio*, *nopal azul*, *cacanapa*, etc., which express certain characteristics that they recognize. The majority of people, however, recognize two forms, and will point with considerable uniformity to a tall, woody, round, and thin-jointed, thorny, usually single-spined form, maturing in late summer, as *cacanapa*, and all others as *nopal*. (See Pls. IV and V.)

The former, they assert, is better feed for horses than for cattle. The cacanapa is doubtless a distinct botanical species, but the other forms are probably variations of a single species. The best pear grows on the best land, and here the plants have much fewer thorns, as a usual thing. The so-called blue pear is also largely an expression of vigor, but is considered the best pear for stock. It is usually free

from dead or diseased joints. However, there may be very good pear with no trace of the blue color which is recognized in certain forms.

In some localities the older portions of the plants are gray, while in others they are yellow. In the vicinity of Encinal the color is almost universally gray, while around San Antonio it is always yellow; but the latter is considered much superior to the former, which is recognized as blue pear by everybody.

From an economic point of view it matters little about the species until the time comes to establish plantations, when the rancher must know which ones are the best feed and which grow the best. Until experimental investigations determine some of these points the statement will suffice that any of the cacti which are large enough and numerous enough to be fed economically are probably good stock feed. Sufficient information is at hand to show that the flat-jointed forms may be fed indiscriminately, and references are made in this publication to experiences in the successful use of several of the long-jointed forms. It is known that during hard times stock will eat the giant cactus greedily when it is chopped up so that they can get at it. The question resolves itself, therefore, purely into one of securing enough material. Any cactus growing large enough to be fed with economy can be used as roughage, or as a succulent for milk production. Some forms are much better adapted for these purposes than others, no doubt; but we have little positive evidence upon this point except that the blue pear of Texas is said to be of greater value than any of the other forms of that region.

ESTABLISHING PLANTATIONS OF PEAR.

Only two or three ranchers have been met who have gone to the trouble of attempting to grow pear by the establishment of new plantations. The plan pursued by Mr. Alexander Sinclair has been a very simple one. The plants have been cut up into individual joints, and these have been scattered at suitable intervals upon the ground. The unequal evaporation upon the two sides soon causes the joint to dish, and new joints spring from its edges, while roots grow from the side in contact with the earth. If the growth is vigorous and normal, three new joints will be produced the first year, three or more the second, and so on, giving a sufficient crop to pay for harvesting in four or five years from planting.

Mr. Sinclair's plantings have been a success in a measure. The areas are well set, but much of the pear is unhealthy, owing to the effect of parasites of both insect and fungus nature. This form of planting is the most simple and least expensive that can be devised. Much experimentation will be necessary to determine the best method of establishing plantations.

YIELD OF PEAR.

During the winter of 1902, Mr. J. C. Glass, of Eagle Pass, Tex., fed pear (Pl. IV, fig. 2) to save his herd, as is the common practice in Texas during drought. The number of cattle that were fed was not constant, for the herd was continually worked over, strong ones being turned out and weaker ones put on feed. When the drought was broken 1,500 cattle were being fed, and an average of not less than 800 were fed for the entire six months. The pear machine was moved into a pear thicket, near a windmill supplying an abundance of fairly good water for this region. It is believed by Mr. Glass that pear was not hauled over a quarter of a mile, and that not more than 80 acres were harvested. The area fed is irregular, the cutting being governed by the quality of the pear, ease of access through the thick mesquite brush, etc. The harvesting was done very closely in places and less so in others, the plants being cut off at the surface of the ground very often, but at other times much was left in the brush. The above account and estimate, therefore, represent, as closely as such estimates permit, the entire yield of pear on a virgin tract—virgin except in the quantity—which had been grazed by stock during the past fifteen or twenty years. This amount, however, is inconsiderable. These data are not definite, but they are the best available, and represent the practices in vogue in prickly-pear regions. Several things should be borne in mind in connection with this account. The conditions might be grouped, in order to present them clearly, as follows:

(1) The feeding was begun after cattle had begun to die.

(2) Feeding was practiced to keep cattle alive, not to fatten them.

(3) The pastures were worked continually, and a watch was kept for weak cattle.

(4) The stronger cattle in the feed pens were constantly being replaced by weaker ones from the pastures.

(5) From 1 to 1½ pounds of cotton-seed meal were fed to each animal, in addition to all the chopped pear it would eat.

(6) All except the very weak cattle were allowed the run of the pastures.

It will be seen from these statements that the stock obtained some feed in addition to the pear and meal, even from the brush pastures where they were dying before the feeding began. No attempt was made to do anything but keep the animals alive until the drought was broken. An effort was made, however, to give the cattle all the pear they would eat. As nearly as can be estimated, therefore, 80 acres of excellent pear furnished a full ration for an average of 800 head of cattle for a period of six months.

BEHAVIOR OF PEAR AFTER HARVESTING.

It is very difficult to get accurate notions of the time that must elapse between successive harvestings of pear even in southwestern Texas, where feeding has been so extensively practiced. The best observations which it has been possible to make thus far were upon the property of Mr. J. C. Glass. As previously stated, harvesting was done very closely upon some portions of his pasture during the winter of 1902–3. It is still too early to tell how long it is going to be before the area can be harvested again. It may be said, however, that about the middle of the second growing season after the harvesting there was abundant proof that the pear will be as thick as ever upon this area. It was observed that many of the old bunches were dead where closely cut. However, the vast majority of them had a joint left somewhere which was growing thriftily, and many joints broken off and left lying on the ground were starting new plants. It is estimated that it will take not less than five years to make a crop which it will pay to harvest. The pear, like everything else, depends upon the season, and the growth is directly proportional to the rainfall.

Several areas have been visited which have been harvested twice during the past four years, but in no case was the crop taken off clean. The best of the virgin crop was taken off one year, and more was harvested two or three years later. These areas, therefore, furnish no data regarding the time necessary to produce a crop. The method of harvesting has a decided influence upon the future growth. It is hard work to secure all of the old stems of the prickly pear, and they are also harder to chop than the younger joints. If only the younger joints are taken off, the old stems grow very vigorously the next few years, and produce a crop much quicker than when chopped off at the surface of the ground; but the feeder invariably desires as much of the old stems as possible.

Mr. Morrill Porr, of San Antonio, estimates that a small area which he planted several years ago can be profitably harvested for dairy purposes every two or three years. This seems a very short time to produce a paying crop of this plant.

OTHER ECONOMIC ASPECTS OF THE CACTI.

The large economic group of cactus plants, which is peculiarly American, has not received in this country the attention it deserves. (See Pl. IV, fig. 1, and Pl. V.) Some of the species naturalized in the Mediterranean countries of three continents form the main article of diet of millions of people during one or more months of each year. Some of the improved forms have been introduced from the Old World into this country. Throughout the Southwest and northern Mexico it is a common and familiar sight to find gigantic forms of the

prickly pear 15 to 20 feet high about the old missions and upon the larger ranches and haciendas. (Pl. IV, fig. 1.)

The fruits are so highly prized by the Italians that there is a limited market for them in the larger cities of this country at the present time. They are imported from Italy, and sold at a price about equal to oranges, bulk for bulk.

The following rather formal list of the uses of these plants, together with what has been said in the body of this bulletin, will give some idea as to the use that is made of them by various peoples:

(1) The fruits of not less than a dozen Mexican species are delicious, and would form a valuable addition to our fruit supply. At least one-half of these are now growing out of doors in private collections of cacti in this country. (Pl. V, fig. 2.)

(2) Very palatable jellies are manufactured from the fruits of some species, and could doubtless, under proper commercial methods, be put upon the market as choice delicacies, if the plants can be successfully grown in sufficient numbers.

(3) The young joints are boiled for food by the Mexican people as greens.

(4) The young joints are manufactured into pickles.

(5) The young joints are chopped into small pieces and dried for future use.

(6) The expressed juices are used by the Mexicans for mixing with whitewash for exterior work.

(7) Many species are used for hedges, borders, fences, and other useful or ornamental plantings.

(8) The pulp of the group of cacti known to the Mexicans by the name of *visnaga* is boiled with sugar in the manufacture of cactus candy.

(9) The soft, pulpy tissues of cacti, being very retentive of moisture, are admirably adapted and extensively used for poultices.

(10) Some species yield valuable drugs.

(11) Before the development of the coal-tar dyes some of the species were largely used as hosts for the cochineal insect.

(12) The peculiar reticulations of the vascular system of many species are taken advantage of in the manufacture of an endless variety of art goods.

SOME CONDITIONS OBTAINING IN THE PRICKLY-PEAR REGION.

There is probably no locality in the United States where labor is so cheap as it is in the prickly-pear region. While it is a poor class, being largely of the Mexican peon type, and not so good, man for man, as the average American labor, wages are so low that many enterprises depending upon the price of labor can be undertaken there when they could not be established elsewhere. The average rancher in many

parts of the region never thinks of doing his own hauling. So low is the price charged by the Mexican freighters that the rancher can not afford to do it himself. The rancher who feeds cotton-seed meal, for instance, buys it of his local merchant, who delivers it at the ranch, often 50 miles distant, the merchant adding to the selling price what he has to pay the local freighter, who hauls it either with oxen or mules, but usually with the former. Here we have the free-delivery system of the city, enlarged to apply to an area of country possibly 100 miles square; but, instead of owning his own teams and hiring his men by the month, the merchant contracts for the hauling with a class of labor that will do it cheaper than he can afford to do it himself. This class of labor has a very potent influence upon the utility of the pear as a cattle feed. Where pear is chopped with a machine there is considerable labor involved, the price of which, of course, governs the profit of feeding. If it is assumed that a crew of 8 men can feed 1,200 cattle—and this is a low estimate—the cost where pear is convenient is very slight with labor at the price that it is here. The itemized expense is about as follows:

Hire of seven men, at 50 cents a day	$3.50
Hire of one foreman	.75
Board of eight men	1.00
Interest on machine and engine per day, when operated four months per year	.15
Gasoline	3.00
Total cost	8.40

The above is probably the minimum cost of a full maintenance ration of pear. In practice, a much larger number of animals can be fed with one machine if the cattle are allowed the run of pastures which contain some browse and dry grass, when the feeding is done simply to carry through a drought.

To the above must be added the cost of whatever meal is fed. As stated on previous pages, the majority of feeders who feed simply to maintain their herds through a drought give each animal 1 pound of cotton-seed meal in addition to the pear. With such a ration, stock make material gains in flesh and strength. Those who feed for the market in closed pens aim to give the stock all the pear they will eat, with a ration of 3 pounds of cotton-seed meal, gradually increased to 6 pounds.

The average wage for a herder is $7 to $10 a month, and board. Formerly the latter consisted of a ration approximately as follows: Two sheep or goats, 40 pounds of corn meal, 4 pounds of coffee, 4 pounds of sugar, and 6 pounds of frijoles. At the present time wages are a little higher, but still not over $12 to $15, with possibly a more liberal bill of fare. A very common practice is to hire for a stated period, for instance, for one year, at $12 or $15 per month, with a forfeiture of $3 per month if the servant quits before the end of the

stipulated time. During dry seasons the rancher in southern Texas has no difficulty whatever in securing help, for the poorer classes of northern Mexico are very needy at these times and are willing to work at as low a rate as 25 cents per day and board.

The gradual extension of the cotton belt into the pear region is destined eventually to have a very potent influence upon the feeding of pear for fattening stock. The use of pear with cotton-seed products is very much in favor. The development of the pumping projects, together with artesian water in some localities, while withdrawing some lands from direct grazing, will contribute nevertheless very materially to stock raising. The areas devoted to cotton culture will especially contribute a valuable support to the stock industry, and the cotton-seed products will find a ready local market. The pear, fed as a roughage, with these cotton-seed products deprived of the present high transportation rates, will add perceptibly to the rancher's ability to mature the beef which he has always been able to breed successfully but not always to fatten economically.

POPULAR POSTULATES OF CACTUS FEEDING.

Data secured from popular sources appear to warrant the following conclusions, many of which are reservedly stated; it is hoped they can be experimentally verified in the near future.

Prickly pear, although poor in nutritive quality, can be fed to decided advantage under several conditions and for several purposes:

(1) To save cattle during a prolonged drought, when other more nutritious feed is scarce.

(2) To fatten cattle, when employed as a roughage with more concentrated feed.

(3) When fed with more concentrated foods and some hay or pasture, it is a valuable accessory to the dairy ration; it supplies succulence which it is difficult to secure in semiarid regions a large part of the year.

(4) Oxen can be worked on a ration consisting very largely of pear for an indefinite period.

A full-grown steer fed on pear alone will consume from 125 to 200 pounds daily.

Mature steers, accustomed to a pear diet, can live in a pear pasture a long time without water.

Oxen worked on pear drink water two or three times a week in summer and once a week in winter.

A good milk ration of pear, with plenty of other nutritious feed, will consist of from 40 to 70 pounds of pear for each animal a day.

Pear, fed whole, especially when stock has little else to eat, is likely to form fiber balls and kill a small percentage of cattle during prolonged feeding.

Pear, when burned, scours cattle much worse than when it is simply scorched enough to take the thorns off.

Pear with many thorns is as easily prepared for the use of stock as that which has but few thorns.

It is quite probable that all the larger species of cactus can be fed to stock to advantage when properly prepared.

Prickly pear and other species of cactus may be fed in a variety of ways:

(1) Cattle accustomed to pear eat more or less of it during the entire year, whether there is plenty of other feed or not, and with no preparation.

(2) The thorns may be scorched off with brush.

(3) The thorns may be scorched off with a gasoline torch—a modified plumber's torch.

(4) The edges of the joints may be trimmed off with a machete, when stock, especially sheep and goats, gain access to the pulpy mass at an advantage.

(5) The plants may be piled in heaps in a field and chopped into small pieces with a machete.

(6) The whole plant may be chopped into pieces ½ to 1 inch long with machines prepared for that purpose.

(7) In some localities the whole plant is steamed in large vats to render the spines innocuous.

A cow, with calf, fed on prickly pear alone will lose flesh very rapidly.

Cotton-seed meal or cake and cotton seed appear to be well adapted to feeding with pear.

Hogs fatten well on the fruit of the prickly pear, and they take kindly to a ration of prickly pear when the thorns are properly singed off.

Stock fed on prickly pear and cotton-seed products are said to suffer heavy shrinkage on the way to market.

Pear as feed for stock is of sufficient value to warrant investigations for the purpose of determining:

(1) How it may best be propagated.

(2) Whether there are species in foreign countries of greater value than those which are native to the Southwest.

(3) Its exact value as food for both man and beast.

(4) The nature and cause of the rapid fermentation in the chopped material.

(5) The comparative value of different species.

(6) The comparative value of old and new growth.

(7) The exact influence upon quantity and quality of milk.

The old woody stems are preferred by feeders to the young joints. When fed for succulence, as is the case in dry weather, the young

nopals (joints) are of more value than when a maintenance, or fattening, ration is desired.

Pear has been fed in Texas since the early Spanish occupation.

Pear is better feed from the time that frost strikes it in the fall until it begins to grow in the spring than in other seasons.

Cattle and working oxen will eat a large ration of pear, properly prepared, when there is an abundance of the best of green grass for them to eat.

Pear has a decided value in toning up the system of cattle that have lived on dry grass for several months. Two-year olds especially are benefited by a partial ration of it for a short time.

All cattle, sheep, and goats soon become accustomed to eating pear. The sound of the pear machine or the sight of smoke in the pastures where stock are fed attracts the entire herd immediately.

The different species and varieties of pear, while of value, differ in their feeding qualities.

The development of pear feeding will increase the utility of concentrated feed stuffs, such as cotton-seed products.

The greatest promise for pear is in the line of milk production. The value of the succulence for the winter months will probably pay for the propagation of small acreages for this purpose.

Burning with a pear burner tends to kill out the pear if close pasturing is practiced afterwards.

It is a mistake to harvest pear too closely unless it is desired to thin it out.

Pear makes sufficient growth in average seasons so that it may be harvested every five years.

When fed a full roughage ration of pear, cattle scour more or less all of the time.

There are four machines on the market for preparing pear for the use of stock—two burners and two choppers.

One man with a pear burner can feed 400 cattle in a brush pasture. The gasoline consumed will range from 6 to 10 gallons per day.

Ten men with a pear chopper can feed from 1,500 to 2,000 cattle under the same conditions.

Inquiry at hide establishments and stock markets fails to reveal any serious injury done by the spines to commercial cattle products, although the spines work into the flesh considerably.

Cattle fed on pear chopped with a machete, and not burned, often get their mouths so full of spines after a time that they are unable to eat at all.

The crushing action of the chopping machine renders the spines innocuous.

Chopped pear sours very quickly, and must, therefore, be fed very soon after being chopped.

Pear cut and piled up moderately will keep in good condition for a month or more, if not left in the sun.

There is no object in preparing ensilage from pear, even if it can be successfully done.

The pear has a large number of enemies, consisting mainly of insects and fungi. Rats and rabbits are also injurious in some seasons.

The pear has two characteristics which render it especially valuable for pastures:

(1) It can withstand long periods of drought without injury. It has limitations, however, in drought resistance. It has been severely injured during some droughts within the memory of the present generation.

(2) It is protected by spines, so that it can not be materially injured by overgrazing without artificial preparation. A thornless pear, in a pasture grazed the entire year, would soon be exterminated.

Pear is not particularly difficult to keep in subjection, nor is it spreading of its own accord to any alarming extent. However, to prepare a pear thicket for cultivation is expensive, for all of the pear must be hauled out of the field. It can not be burned like brush.

There are many areas in extreme southwestern Texas where pear is so thick as to interfere with the growth of grass. The feeding here should be done with the view of thinning the pear rather than destroying it.

The destruction of the pear in southwestern Texas would be a severe calamity to the stock industry.

The practice of preparing pear with a machete by cutting off the edges of the joints tends to form pear thickets, which is often disadvantageous.

In practice, pear is very seldom fed alone. Even during the severest drought cattle are able to pick up some old grass and get a little browse from the abundance of brush that exists throughout the pear region. It is seldom that the Texas rancher feeds it without some cotton-seed meal, although the cactus of southwestern Colorado has usually been fed alone.

Cacti have many uses besides that of forage.

Prickly pear, including several species in southwestern Texas, the cane cactus of southeastern Colorado and New Mexico, and the cholla and related species in one or two localities in Arizona, are the only species of cactus that have been fed to any extent in this country.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.* Old and new ways of singeing cacti. Fig. 1.—The cane cactus of southeastern Colorado, singed with brush. April, 1904. Fig. 2.—The prickly pear of Texas, singed with a torch. This is a typical illustration of the method largely employed throughout southern Texas of destroying the evil effect of the spines by singeing with a blast flame from a gasoline torch especially prepared for this purpose. Sinclair ranch, near San Antonio, Tex., May, 1904.

PLATE II. The prickly pear and a pear machine. Fig. 1.—One of the common prickly pears of Texas in full fruit. This plant is bearing rather abnormally this year. Glass ranch, near Eagle Pass, Tex., May, 1904. Fig. 2.—A type of pear cutter as set up and operated by Mr. J. C. Glass two years ago. Machine as seen from the horsepower platform. May, 1904.

PLATE III. Another type of pear cutter. Fig. 1.—Front view, showing knives, together with a sheet-iron shield which acts as a back stop for the pear, which is fed against the face of the revolving wheel. June, 1904. Fig. 2.—Rear view, with casing removed, showing the boxes behind the knives into which the chopped pear passes and is carried out of the machine. The delivery opening of one of these is shown on the left. June, 1904.

PLATE IV. Fig. 1.—Nopal de Castilla, cultivated in southern California. Such a scene as this is common in the vicinity of the old missions and larger haciendas throughout northern Mexico and the southwestern United States. This plantation is doubtless upward of 30 years of age, and some of the plants are 20 to 25 feet high. Fig. 2.—A pear thicket on the Glass ranch, Eagle Pass, Tex. This is typical of large areas in this part of Texas. May, 1904.

PLATE V. The Tapuna pear. Fig. 1.—A single plant of the Tapuna pear near Alonzo, Mexico. The fruits of this species are highly prized as an article of diet, and are about the first that appear in the markets of San Luis Potosi. The spines are not numerous and the joints are very thick and succulent. Alonzo, Mexico, June, 1904. Fig. 2.—Fruit of the Tapuna pear in one of the market places at San Luis Potosi, Mexico. June, 1904.

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FIG. 1.—ONE OF THE COMMON PRICKLY PEARS OF TEXAS IN FULL FRUIT.

FIG. 2.—A TYPE OF PEAR CUTTER, AS SET UP AND OPERATED BY J. C. GLASS.

THE PRICKLY PEAR AND A PEAR MACHINE.

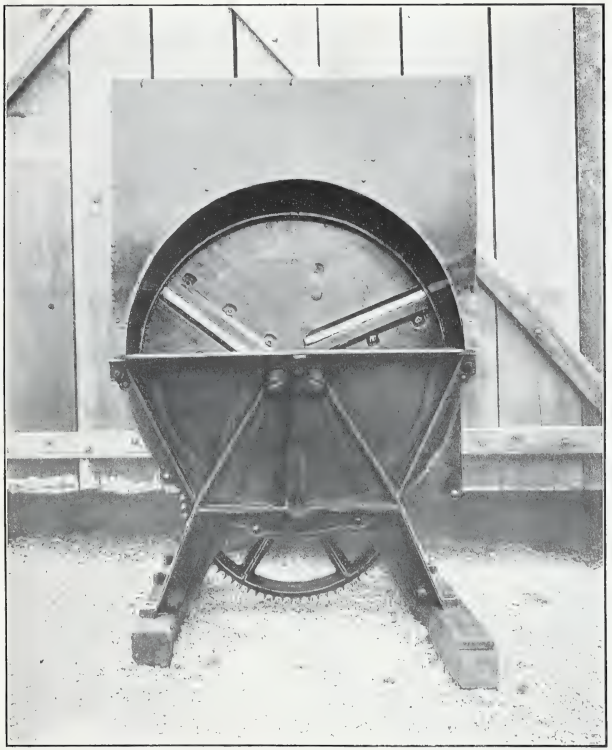

FIG. 1.—FRONT VIEW, SHOWING KNIVES.

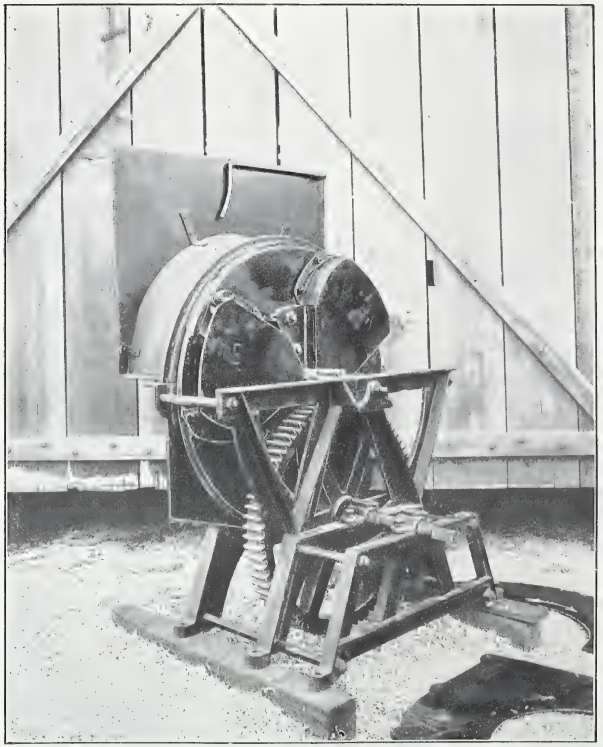

FIG. 2.—REAR VIEW, WITH CASING REMOVED, SHOWING BOXES BEHIND THE KNIVES.

ANOTHER TYPE OF PEAR CUTTER.

FIG. 1.—NOPAL DE CASTILLA, CULTIVATED IN SOUTHERN CALIFORNIA

FIG. 2.—A PEAR THICKET ON THE GLASS RANCH, EAGLE PASS, TEX.

PRICKLY PEARS IN CALIFORNIA AND TEXAS.

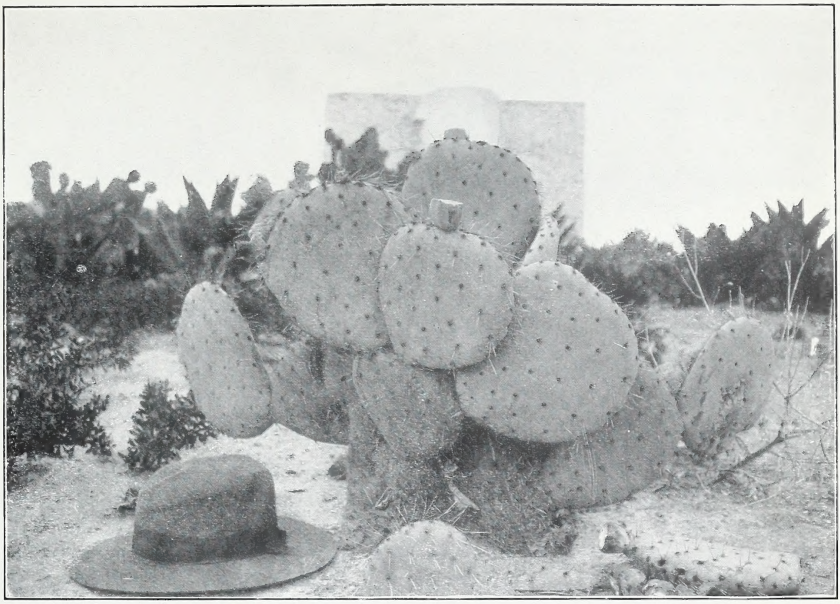

FIG. 1.—A SINGLE PLANT OF TAPUNA PEAR, NEAR ALONZO, MEXICO.

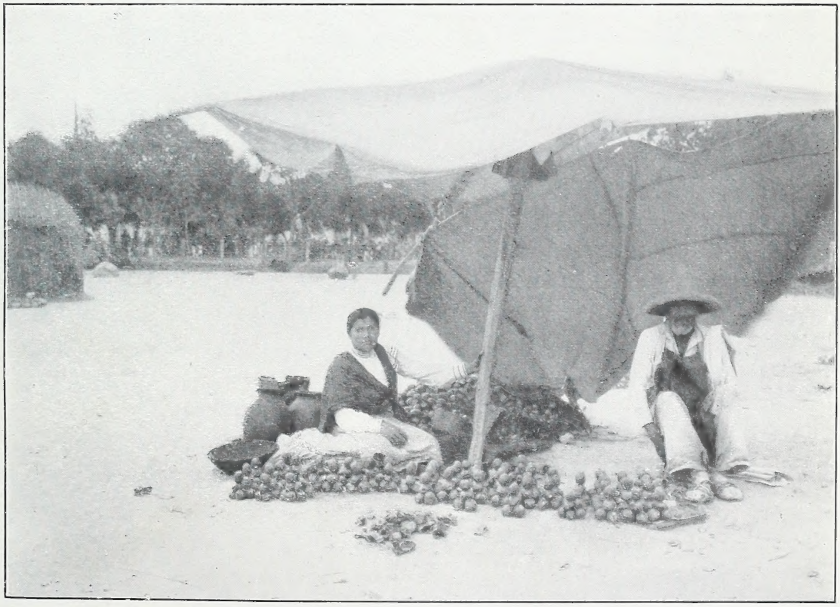

FIG. 2.—FRUIT OF THE TAPUNA PEAR IN ONE OF THE MARKET PLACES AT SAN LUIS POTOSI, MEXICO.